Sub F1

2040. (amended) The method of claim 2039, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

2041. (amended) The method of claim 2039, further comprising maintaining a temperature within the part of the formation within a pyrolysis temperature range.

2042. (amended) The method of claim 2039, wherein at least one of the one or more heaters comprises an electrical heater.

2043. (amended) The method of claim 2039, wherein at least one of the one or more heaters comprises a surface burner.

C3

Sub F1

2044. (amended) The method of claim 2039, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

2045. (amended) The method of claim 2039, wherein at least one of the one or more heaters comprises a natural distributed combustor.

2046. (amended) The method of claim 2039, further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

2047. (amended) The method of claim 2039, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during pyrolysis.

Sub E2

2048. (amended) The method of claim 2039, wherein providing heat from the one or more heaters to at least the portion of formation comprises:

heating a selected volume (V) of the coal formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$; wherein ρ_B is an average formation bulk density, and wherein an average heating rate (h) of the selected volume is less than about 10 °C/day.

2050. (amended) The method of claim 2039, wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).

2062. (amended) The method of claim 2039, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component.

2065. (amended) The method of claim 2039, further comprising controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

2070. (amended) The method of claim 2039, further comprising:

providing hydrogen (H_2) to the heated part of the formation to hydrogenate hydrocarbons within the part of the formation; and

heating a portion of the part of the formation with heat from hydrogenation.

2072. (amended) The method of claim 2039, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

C8 Sub E3

2073. (amended) The method of claim 2039, wherein allowing the heat to transfer further comprises substantially uniformly increasing a permeability of at least a majority of the part of the formation.

Sub F1

2075. (amended) The method of claim 2039, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

2076. (amended) The method of claim 2039, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

C9

2077. (amended) The method of claim 2039, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

Sub E4

2078. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more heaters to a part of the formation;

allowing the heat to transfer from the one or more heaters to the part of the formation;

wherein at least a portion of the part of the formation has an initial moisture content of less than about 15%; and

producing a mixture from the formation.

Sub F1

2079. (amended) The method of claim 2078, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

Sub F1

2080. (amended) The method of claim 2078, further comprising maintaining a temperature within the part of the formation within a pyrolysis temperature range.

2081. (amended) The method of claim 2078, wherein at least one of the one or more heaters comprises an electrical heater.

2082. (amended) The method of claim 2078, wherein at least one of the one or more heaters comprises a surface burner.

Sub F1

2083. (amended) The method of claim 2078, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

2084. (amended) The method of claim 2078, wherein at least one of the one or more heaters comprises a natural distributed combustor.

2085. (amended) The method of claim 2078, further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

2086. (amended) The method of claim 2078, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during pyrolysis.

Sub E7

2087. (amended) The method of claim 2078, wherein providing heat from the one or more heaters to at least the portion of formation comprises:

heating a selected volume (V) of the coal formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

C9 Sub E7

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$; wherein ρ_B is an average formation bulk density, and wherein the heating rate (h) of the selected volume is less than about 10 °C/day.

C10 Sub E8

2089. (amended) The method of claim 2078, wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).

C11 Sub E9

2101. (amended) The method of claim 2078, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component.

C12 Sub F1

2104. (amended) The method of claim 2078, further comprising controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

C13 Sub F1

2109. (amended) The method of claim 2078, further comprising:

providing hydrogen (H_2) to the heated part of the formation to hydrogenate hydrocarbons within the part of the formation; and

heating a portion of the part of the formation with heat from hydrogenation.

Sub E10 C14

2111. (amended) The method of claim 2078, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

2112. (amended) The method of claim 2078, wherein allowing the heat to transfer further comprises substantially uniformly increasing a permeability of at least a majority of the part of the formation.

Sub F1

2114. (amended) The method of claim 2078, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

C15

2115. (amended) The method of claim 2078, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

2116. (amended) The method of claim 2078, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

Sub E11

5150. (new) A method of treating a coal formation in situ, comprising:

evaluating a moisture content of coal in the coal formation to identify a portion of the coal with an moisture content that is less than about 20%;

providing heat from one or more heaters to the portion to raise temperature in the portion so that an average temperature in the portion is above a temperature sufficient to pyrolyze coal in the portion; and

producing a mixture from the coal formation.

C16

Sub F1

5151. (new) The method of 5150, further comprising controlling a pressure and temperature within at least a majority of the portion, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

Sub E12

5152. (new) The method of 5150, wherein providing heat from one or more heaters to the portion comprises providing heat to a portion of the hydrocarbon containing material identified as having a moisture content that is less than about 15%.

5153. (new) The method of 5150, wherein providing heat from one or more heaters to the portion comprises providing heat to a portion of the hydrocarbon containing material identified as having a moisture content that is less than about 10%.

16

Sub F1

5154. (new) The method of 5150, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

5155. (new) The method of 5150, wherein providing heat from the one or more heaters to at least the portion of the coal formation comprises:

heating a selected volume (V) of the coal formation from the one or more heaters, wherein the coal formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some coal within the selected volume of the coal formation; and

wherein heating energy/day (Pwr)provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is an average formation bulk density, and wherein an average heating rate (h) of the selected volume is less than about 10 °C/day.

<u>Response to Office Action Mailed June 25, 2002</u>

A. <u>Pending Claims</u>

Claims 2039-2116, 5150-5155 are pending. Claims 2039-2048, 2050, 2062, 2065, 2070, 2072-2073, 2075-2087, 2089, 2101, 2104, 2109, 2111-2112 and 2114-2116 have been amended. Claims 5150-5155 are new.

B. Submission of Corrected Formal Drawings

In the Office Action mailed June 25, 2002, the Examiner indicated approval of the proposed drawing corrections filed on February 26, 2002. Applicant submits the corrected formal drawings approved by the Examiner.

C. Provisional Double Patenting Rejection

The Examiner provisionally rejected claims 2039-2116 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims of copending U.S. Patent Application Nos.:

09/840,936; 09/840,937, 09/841,000; 09/841,060; 09/841,061; 09/841,127; 09/841,128; 09/841,129; 09/841,130; 09/841,131; 09/841,170; 09/841,193; 09/841,194; 09/841,195; 09/841,238; 09/841,239; 09/841,240; 09/841,283; 09/841,284; 09/841,285; 09/841,286; 09/841,287; 09/841,288; 09/841,289; 09/841,290; 09/841,291; 09/841,292; 09/841,293; 09/841,294; 09/841,295; 09/841,296; 09/841,297; 09/841,298; 09/841,299; 09/841,300; 09/841,301; 09/841,302; 09/841,303; 09/841,304; 09/841,305; 09/841,306; 09/841,307; 09/841,308; 09/841,309; 09/841,310; 09/841,311; 09/841,312; 09/841,429; 09/841,430; 09/841,431; 09/841,432; 09/841,433; 09/841,434; 09/841,435; 09/841,436; 09/841,437; 09/841,438; 09/841,439; 09/841,440; 09/841,441; 09/841,443; 09/841,444; 09/841,445; 09/841,446; 09/841,447; 09/841,448; 09/841,449; 09/841,488; 09/841,489; 09/841,490; 09/841,491; 09/841,492; 09/841,493; 09/841,494; 09/841,495; 09/841,496; 09/841,497; 09/841,498; 09/841,499; 09/841,500; 09/841,501; 09/841,502; 09/841,632; 09/841,633; 09/841,634; 09/841,635; 09/841,636; 09/841,637; 09/841,638; and 09/841,639.

Applicant respectfully traverses the provisional double patenting rejection. Applicant respectfully submits that the omnibus nature of this rejection does not provide Applicant with sufficient detail in which to address such rejection. Applicant also respectfully submits that the rejection is also inconsistent with certain restrictions issued in the above-referenced cases. Applicant respectfully requests reconsideration.

Pursuant to the discussion in an Examiner interview on August 19, 2002, for the

convenience of the Examiner, Applicant will forward copies of allowed claims for the above-referenced cases to the Examiner. Applicant understands that the Examiner will review the allowed claims for the above-referenced cases and then reconsider the double patenting rejection in view of such allowed claims.

D. The Claims Are Definite Pursuant To 35 U.S.C. § 112, Second Paragraph

Claims 2039-2116 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant respectfully disagrees with these rejections.

The Examiner has rejected claims 2075 and 2114 as being unclear regarding "at least about 7 heat sources. The modified "about" is not normally used in reference to an integer count (i.e., a number of sources); thus it is unclear what the scope of the claim is."

The fact that claim language, including terms of degree, may not be precise, does not automatically render the claim indefinite under 35 U.S.C. 112, second paragraph. Seattle Box Co., v. Industrial Crating & Packing, Inc., 731 F.2d 818, 221 U.S.P.Q. 568 (Fed. Cir. 1984).

Applicant submits that the number of heat sources per well is a number of heat sources per production well in a unit cell of the formation. Support for this interpretation is found at least in the paragraphs of the specification cited below.

> The total number of heat sources 400 in unit cell 404 may include six full heat sources 400a that are each counted as one heat source, and six partial heat sources 400b that are each counted as one half of a heat source. Therefore, a ratio of heat sources 400 to production wells 402 in unit cell 404 may be determined as 9:1. A ratio of heat sources to production wells may vary, however, depending on, for example, the desired heating rate of the hydrocarbon containing formation, the heating rate of the heat sources, the type of heat source, the type of hydrocarbon containing formation, the composition of hydrocarbon containing formation, the desired composition of the produced fluid, and/or the desired production rate. Providing more heat sources wells per unit area will allow faster

heating of the selected portion and thus hastening the onset of production, however more heat sources will generally cost more money to install. An appropriate ratio of heat sources to production wells may also include ratios greater than about 5:1, and ratios greater than about 7:1. In some embodiments an appropriate ratio of heat sources to production wells may be about 10:1, 20:1, 50:1 or greater. If larger ratios are used, then project costs tend to decrease since less wells and equipment are needed.
(Specification, page 61, lines 18-31).

In FIG. 58, production well 2701 and heat source 2712 may be located at the apices of a triangular grid. The triangular grid may be an equilateral triangular grid with sides of length, s. Production wells 2701 may be spaced at a distance of about 1.732(s). Production well 2701 may be disposed at a center of a hexagonal pattern with one ring 2713 of six heat sources 2712. Each heat source 2712 may provide substantially equal amounts of heat to three production wells. Therefore, each ring 2713 of six heat sources 2712 may contribute approximately two equivalent heat sources per production well 2701.
(Specification, page 166, line 15-21)

Thus, Applicant submits that "about 7 heat sources" in claims 2075 and 2114 do not refer to an integer number of heat sources, but rather to the effective number of heat sources per production well. Applicant has amended claims 2075 and 2114 for clarification. Applicant respectfully submits the amendments to these claims do not substantively change the scope of the claims.

The Examiner objected to Applicant's definition of hydrocarbon. The Examiner states "While applicant may be his or her own lexicographer, a term in a claim may not be given a meaning repugnant to the usual meaning of the that term...Applicant's vague definition of "hydrocarbon" is much broader than the accepted meaning of the term and this makes it impossible for one of ordinary skill in the art to ascertain the scope of the claims, which include the term 'hydrocarbon'." Applicant respectfully disagrees.

Applicant respectfully submits that Applicant has used an accepted meaning of the term "hydrocarbon" as defined by one of ordinary skill in the art. Support for this definition can be found in references within and associated with the art of the petroleum industry. For example, a reference within the art gives the following definition: "**Hydrocarbons**: molecules formed

primarily by carbon and hydrogen atoms" (Hyne, N. J. *Geology for Petroleum Exploration, Drilling, and Production*, 1984, McGraw-Hill Book Company, pg. 264). The specification (page 38, paragraph beginning on line 14) has been amended for clarification. Applicant therefore respectfully requests removal of the rejection of Applicant's definition of the term "hydrocarbon."

The Examiner states "Claims 2048 and 2087 call for the heating energy to be equal to or less than Pwr. Pwr is defined using an ideal equation for heating. Since this equation fails to take into account the endothermic nature of pyrolysis reactions, and heat loss to adjacent formations; it is not clear how the heating energy can be equal to or less than Pwr." Applicant respectfully disagrees with the rejection. Applicant has amended the claims for clarification. Applicant submits that the amendments do not narrow the scope of the claims.

The Examiner rejected claim 2062 and 2101 as being unclear regarding "non-condensable component." Applicant respectfully disagrees with the rejection. Support for "non-condensable component" is found in Applicant's specification, which states,

> Hydrocarbons in the produced fluids may include a mixture of a number of different components, some of which are condensable and some of which are not. The fraction of non-condensable hydrocarbons within the produced fluid may be altered and/or controlled by altering, controlling, and/or maintaining a temperature within a pyrolysis temperature range in a heated portion of the hydrocarbon containing formation. Additionally, the fraction of non-condensable hydrocarbons within the produced fluids may be altered and/or controlled by altering, controlling, and/or maintaining a pressure within the heated portion. In some embodiments, surface facilities may be configured to separate condensable and non-condensable hydrocarbons of a produced fluid.
> (Specification, page 127, lines 9-16).

In addition, the Examiner rejected claim 2062 and 2101 as being unclear regarding a "benchmark temperature and pressure." Applicant has amended claims 2062 and 2101 to include conditions of 25 °C and one atmosphere absolute pressure, as described in the definition of "non-condensable hydrocarbons" on page 33, lines 21-22 of the specification.

Claims 2041 and 2080 were rejected as being unclear regarding "a pyrolysis temperature range." Applicant has amended claims 2041 and 2080 for clarification. Applicant submits that the amendment does not narrow the scope of the claim. Support for this amendment can be found in Applicant's specification which states, "In an alternative embodiment, a pyrolysis temperature range may include temperatures between about 270 °C to about 400 °C." (Specification, page 36, lines 21-22). Applicant submits that the amendment to these claims does not narrow the scope of the claims.

The Examiner states, "claims 2073 and 2112 are unclear regarding "substantially uniformly increasing a permeability." The specification states: "In the context of this patent "substantially uniform permeability" means that the assessed (e.g., calculated or estimated) permeability of any selected portion in the formation does not vary by more than a factor of 10 from the assessed average permeability of such selected portion." (Specification, page 137, lines 12-15). Applicant does not believe that the claims are unclear.

The Examiner states, "claims 2047 and 2086 are unclear regarding 'during pyrolysis'." Claims 2047 and 2086 have been amended for clarification. Applicant submits that the amendment to these claims does not narrow the scope of the claims.

E. <u>The Claims Are Not Anticipated By Tsai et al. Pursuant To 35 U.S.C. § 102(b)</u>

The Examiner rejected claims 2039, 2041, 2044, 2045, 2049, 2065, 2072-2074, 2078, 2080, 2083, 2088, 2104 and 2111-2113 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,299,285 to Tasi et al. (hereinafter "Tsai"). Applicant respectfully disagrees with the rejection.

The standard for "anticipation" is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v.*

Monoclonal Antibodies, Inc., 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed.Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed.Cir. 1985).

Amended claims 2039 and 2078 describe a combination of features including, but not limited to, "providing heat from one or more heaters to at least a portion of the formation." Support for amendment to the claims is found at least in the specification as follows:

> A "heater" is generally defined as any system configured to generate heat in a well or a near wellbore region. A "unit of heat sources" refers to a minimal number of heat sources that form a template that is repeated to create a pattern of heat sources within a formation. For example, a heater may generate heat by burning a fuel external to or within a formation such as surface burners, flameless distributed combustors, and natural distributed combustors, as described in embodiments herein
> (Specification, p. 31, lines 14-19).
>
> Heat sources 100 may include, for example, electrical heaters such as insulated conductors, conductor-in-conduit heaters, surface burners, flameless distributed combustors, and/or natural distributed combustors. Heat sources 100 may also include other types of heaters
> (Specification, p. 46, lines 3-6).

Applicant submits that Tsai do not appear to teach or suggest at least the above-mentioned features, in combination with the other features of the claims. Tsai states, "the oxidizing gas is injected into the injection hole at an appropriate rate and the fire is started in the coal bed at the injection well" (Column.2, lines 30-33). Applicant respectfully submits that Tsai does not appear to teach or suggest providing heat from one or more heaters to a part of the formation.

Applicant submits that the cited art does not appear to teach the combination of features in claims 2039 and 2078 including, but not limited to, heaters. Applicant submits that claims 2039 and 2078 are allowable over the cited art.

Applicant submits that many of the claims dependent on claims 2039 and 2078 may be separately patentable.

Amended claims 2041 and 2080 describe a combination of features including: "further comprising maintaining a temperature within the part of the formation within a pyrolysis temperature range from about 270 °C to about 400 °C." Applicant submits that the amended features of claim 2041 and 2080 are supported by Applicant's specification on at least page 36, lines 21-22.

The Examiner states, "the Tsai reference teaches a pyrolysis temperature range within a section of the formation (see col. 4, line 54). Applicant submits that Tsai does not appear to teach a pyrolysis temperature range in a part of the formation. Tsai appears to teach a heating air to within a range of temperatures, which may vaporize some moisture and in the coal. Tsai states,

> In general, we prefer that the temperature of the heated air be a maximum of about 350 °C. and most prefer that the maximum temperature be about 300 °C. The range of about 150 °C. to about 300 °C. is a particularly suitable operating range. (Column 3, lines 41-45)
>
> Initially, there is a vaporization of moisture from the coal and a loss of some volatile carbonaceous material. Some of this may be the result of a minor pyrolysis of the coal. (Column 4, lines 51-54).

Applicant submits that for the reasons cited above the features of claims 2041 and 2080, in combination with the features of independent claim 2039 and 2078, respectively, do not appear to be taught by Tsai.

Claims 2044, 2083, 2045 and 2084 describe the features of a flameless combustor and a natural distributed combustor. The Examiner states,

> with regard to claims 2044; the Tsai reference teaches a flameless combustor (col. 2, line 32). [W]ith regards to claims 2083; the Tsai reference teaches a natural distributed combustor (col. 2., line 32).

with regard to claims 2045; the Tsai reference teaches a flameless combustor (col. 2, line 32). [W]ith regards to claims 2084; the Tsai reference teaches a natural distributed combustor (col. 2, line 32).

Applicant's specification teaches,

Flameless combustion may be accomplished by preheating a fuel and combustion air to a temperature above an auto-ignition temperature of the mixture. The fuel and combustion air may be mixed in a heating zone to combust. In the heating zone of the flameless combustor, a catalytic surface may be provided to lower the auto-ignition temperature of the fuel and air mixture.
(Specification, page 4, lines 22-26)

As used herein, the phrase "natural distributed combustor" generally refers to a heater that uses an oxidant to oxidize at least a portion of the carbon in the formation to generate heat, and wherein the oxidation takes place in a vicinity proximate to a wellbore. Most of the combustion products produced in the natural distributed combustor are removed through the wellbore
(Specification, page 31, lines 26-31).

Tsai does not appear to teach a heater such as a natural distributed combustor or a flameless combustor. Tsai appears to teach starting a fire in the coal bed. Tsai states, "the oxidizing gas is injected into the injection hole at an appropriate rate and the fire is started in the coal bed a the injection well." (Column 2, lines 31-34).

Applicant submits that the combination of the features in claims 2044, 2083, 2045 and 2084 in combination with the feature of independent claims 2039 and 2078, respectively, do not appear to be taught by the cited art for at least the reasons cited above.

Claims 2049 and 2088 describe a combination of features including, "wherein allowing the heat to transfer from the one or more heat sources to the part of the formation comprises transferring heat substantially by conduction."

The Examiner states,

> the Tsai reference does not explicitly teach the transferring by conduction; however this is inherent in a solid substance such as coal. Even though the bulk of the heating in the Tsai method may be done by convection; it is apparent that some unfractured coal must remain, and thus the allowing heat to transfer comprises transferring heat substantially by conduction
> (Office Action, page 8 and page 9).

Applicant respectfully disagrees with this rejection. Tsai appears to teach increasing permeability by fracturing the coal bed to allow the hot air to permeate the formation. Tsai states,

> This link or channel between wells can be naturally occurring permeability in the coal seam involving cracks, fissures and the like. But since naturally occurring paths of suitable gas flow capacity are rare, it is generally necessary by some suitable means to significantly enhance a naturally occurring path or it may be necessary to produce an artificial path for high volume, low pressure gas flow between the injection and production wells. One solution involves the fracturing of the coal bed by injecting under substantial pressure an aqueous mixture containing suitable entrained particles as propping agents t open up fracture planes and channels in which the particles settle out to prop the fractures open when the pressure is released. Another method involves the directional drilling of one or more holes through the coal bed, generally along the bottom portion of the bed, between the injection and production holes. Other linking methods or combinations of linking methods can be used to obtain the linkage between the wells.
> (Column. 2, lines 9-29)

Furthermore, Tsai appears to teach in situ combustion and gasification in an area between injection wells and production wells to produce a combustible gas from the formation. Tsai discloses:

> Air is heated to a temperature of about 250° C. and is injected into the injection well at a pressure of approximately 500 psi (35.2 kg/cm^2) and at a rate of about 300 ft^3/min (8.5 m^3/min) (standardized to one atmosphere and 15.6° C.). Injection is continued at this rate for five days. Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi (3.51 kg/cm^2) and at a rate of 1,500 ft^3/min (42.5 m^3/min) (standardized to one atmosphere and 15.6° C.), and a fire is ignited in the coal at the bottom of the injection well. After the underground combustion stabilizes, a combustible product gas is obtained at the production well.

(Column 7, line 62-Column. 8, line 17)

Applicant submits that it is not inherent that the invention of Tsai would conduct heat into the formation and heat the formation enough to produce a mixture from the formation. Applicant submits that portions of the aforementioned rejection appears to be set forth in facts within the personal knowledge of the Examiner. Applicant respectfully submits that the cited art does not appear to teach or suggest the features of claims 2049 and 2088 in combination with independent claim 2039 and 2078.

Amended claims 2065 and 2104 describe features including, but not limited to, "controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute." The Examiner states, "the Tsai reference teaches the pressure greater than 2.0 bar."

Applicant submits that Tsai does not appear to teach controlling pressure within at least a majority of the part of the formation at least about 2.0 bar absolute. Tsai appears to teach or suggest injecting air at a pressure for approximately 500 psi or approximately 50 psi. Tsai states,

> Air is heated to a temperature of about 250° C. and is injected into the injection well at a pressure of approximately 500 psi (35.2 kg/cm^2) and at a rate of about 300 ft^3/min (8.5 m^3/min) (standardized to one atmosphere and 15.6° C.). Injection is continued at this rate for five days. Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi (3.51 kg/cm^2) and at a rate of 1,500 ft^3/min (42.5 m^3/min) (standardized to one atmosphere and 15.6° C.), and a fire is ignited in the coal at the bottom of the injection well. After the underground combustion stabilizes, a combustible product gas is obtained at the production well.
> (Column 7, line 62 to column 8, line 17)

Applicant submits that the features of claim 2065 and 2104, in combination with the features of independent claim 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Amended claims 2072 and 2111 describe a combination of features including, "wherein allowing the heat to transfer comprises increasing a permeability of at least a majority of the part of the formation to greater than about 100 millidarcy." Amended claims 2073 and 2112 describe a combination of features including, "wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of at least a majority of the part of the formation."

The Examiner states, "the Tsai reference teaches the permeability greater than about 100 md in table 1. The uniform increase in permeability is inherent." Applicant respectfully disagrees with the rejection.

Applicant submits that Tsai does not appear to teach increasing at least a majority of the part of the formation to greater than 100 millidarcy. Applicant further submits that Tsai does not appear to teach substantially uniformly increasing a permeability of at least a majority of the part of the formation. Tsai appears to teach heating the core and recording the permeability. Tsai also does not appear to teach a substantially uniform increase in the permeability.

Tsai states, "The initial permeability of the core was 2.0, after two days it was 27.5, after three days is was 77.2 and after four days it was 107 as reported in Table I." (Tsai, column 7, lines 11-14). Referring to TABLE I, Tsai appears to teach a permeability of 107 md for Ex. 6 and a permeability of 148 md for Ex. 7, in which the axis of the core was perpendicular to the bedding plane. Tsai does not appear to teach or suggest at least the feature of wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.

Thus, Applicant submits that the features of claims 2072, 2073, 2111 and 2112, in combination with the features of independent claim 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2074 and 2113 describe a combination of features including "further comprising

controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by the Fischer Assay." Applicant's specification teaches, "The Fischer Assay is a standard method which involves heating a sample of a hydrocarbon containing layer to approximately 500 °C in one hour, collecting products produced from the heated sample, and quantifying the amount of products produced." (Specification, page 45, lines 25-28).

The Examiner states, "although the Tsai reference fails to explicitly disclose a Fischer Assay; it is apparent that the disclosed process will yield greater than 60%."

Applicant submits that Tsai does not appear to teach a yield greater than 60%. Tsai appears to teach a volatile content (i.e., a yield) of 31 percent that contains greater than 84 percent carbon. Tsai states, "a volatile content of 31 percent, an ash content of 2.12 percent and a heating value of 15,200 Btu/lb (8,460 kcal/kg). Elemental analysis showed 84.73 percent carbon, 4.63 percent hydrogen, 3.1 percent oxygen and 0.59 percent sulfur. Nitrogen was not determined." (Column 6, lines 46-51).

Applicant submits that the Examiner is extending the teaching of Tsai to increase the yield from 31% to 60%. Applicant submits that the increase in yield is not inherent to Tsai. Therefore, Applicant submits that the features of claims 2074 and 2113, in combination with the features of independent claim 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art or are inherent to the cited art.

Applicant submits that portions of the aforementioned rejection appears to be set forth in facts within the personal knowledge of the Examiner. Applicant therefore believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicant requests this rejection be removed.

F. <u>The Claims Are Not Obvious Over Tsai Pursuant To 35 U.S.C. § 103(a)</u>

The Examiner rejected claims 2040, 2042, 2043, 2050-2062, 2066, 2067, 2079, 2081, 2082, 2089-2101, 2105 and 2106 under 35 U.S.C. § 103(a) as being unpatentable over Tsai. Applicant respectfully disagrees.

In order to reject a claim as obvious, the Examiner has the burden of establishing a *prima facie* case of obviousness. *In re Warner et al.,* 379 F.2d 1011, 154 USPQ 173, 177-178 (CCPA 1967). To establish a *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03.

Amended claims 2040 and 2079 describe a combination of features including "wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation."

The Examiner states, "the Tsai reference fails to explicitly teach the superposition of heat sources. It is apparent that one of ordinary skill in the art would know that the heat sources should be space to substantially heat the entire formation."

Applicant's specification teaches,

> One or more heat sources may be located within the formation such that superposition of heat produced from one or more heat sources may occur. Superposition of heat may increase a temperature of the selected section to a temperature sufficient for pyrolysis of at least some of the hydrocarbons within the selected section. Superposition of heat may vary depending on, for example, a spacing between heat sources. The spacing between heat sources may be selected to optimize heating of the section selected for treatment. Therefore, hydrocarbons may be pyrolyzed within a larger area of the portion. In this manner, spacing between heat sources may be selected to increase the effectiveness of the heat sources, thereby increasing the economic viability of a selected in situ conversion process for hydrocarbons. Superposition of heat tends to increase the uniformity of heat distribution in the section of the formation selected for treatment (Specification, page 9, lines 4-14).

In some embodiments, a plurality of heated portions may exist within a unit of heat sources. A unit of heat sources refers to a minimal number of heat sources that form a template that may be repeated to create a pattern of heat sources within the formation. The heat sources may be located within the formation such that superposition (overlapping) of heat produced from the heat sources is effective. For example, as illustrated in FIG. 7, transfer of heat from two or more heat sources 330 results in superposition of heat 332 to be effective within an area defined by the unit of heat sources. Superposition may also be effective within an interior of a region defined by two, three, four, five, six or more heat sources. For example, an area in which superposition of heat 332 is effective includes an area to which significant heat is transferred by two or more heat sources of the unit of heat sources. An area in which superposition of heat is effective may vary depending upon, for example, the spacings between heat sources (Specification, p. 52, lines 17-28).

Superposition of heat may increase a temperature in at least a portion of the formation to a temperature sufficient for pyrolysis of hydrocarbon within the portion. In this manner, superposition of heat 332 tends to increase the amount of hydrocarbon in a formation that may be pyrolyzed. As such, a plurality of areas that are within a pyrolysis temperature range may exist within the unit of heat sources. The selected sections 334 may include areas at a pyrolysis temperature range due to heat transfer from only one heat source, as well as areas at a pyrolysis temperature range due to superposition of heat (Specification, page 52, line 30 through page 53, line 5).

In addition, a pattern of heat sources will often include a plurality of units of heat sources. There will typically be a plurality of heated portions, as well as selected sections within the pattern of heat sources. The plurality of heated portions and selected sections may be configured as described herein. Superposition of heat within a pattern of heat sources may decrease the time necessary to reach pyrolysis temperatures within the multitude of heated portions. Superposition of heat may allow for a relatively large spacing between adjacent heat sources, which may in turn provide a relatively slow rate of heating of the coal formation. In certain embodiments, superposition of heat will also generate fluids substantially uniformly from a heated portion of a coal formation (Specification, page 53, lines 7-15).

In some embodiments, superposition (e.g., overlapping) of heat from one or more heat sources may result in substantially uniform heating of a portion of a coal formation. Since formations during heating will typically have temperature profiles throughout them, in the context of this patent "substantially uniform" heating means heating such that the temperatures in a majority of the section do not vary by more than 100 °C from the assessed average temperature

in the majority of the selected section (volume) being treated (Specification, page 137, lines 26-31).

Tsai appears to teach in situ combustion and gasification in an area between injection wells and production wells to produce a combustible gas from the formation. Tsai states,

> The spacing, orientation and linking of wells into a predetermined pattern for an orderly, progressive burn of the coal deposit for maximum economy in recovery of the coal's heating values is a known art.
> (Column 1, line 69 through Column 2, line 1-4).
>
> Air is heated to a temperature of about 250° C. and is injected into the injection well at a pressure of approximately 500 psi (35.2 kg/cm^2) and at a rate of about 300 ft^3/min (8.5 m^3/min) (standardized to one atmosphere and 15.6° C.). Injection is continued at this rate for five days. Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi (3.51 kg/cm^2) and at a rate of 1,500 ft^3/min (42.5 m^3/min) (standardized to one atmosphere and 15.6° C.), and a fire is ignited in the coal at the bottom of the injection well. After the underground combustion stabilizes, a combustible product gas is obtained at the production well.
> (Column 7, line 62 to column 8, line 17).

Applicant submits that, while superposition of heat may be achieved by various heat source configurations, the Examiner is extending the teaching of Tsai by suggesting that "any configuration of heat sources that provides heat to the entire formation" would confer the unexpected advantages of superposition of heaters described above in the Applicant's specification. Thus, Applicant submits the features of claims 2040 and 2079, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Amended claims 2042 and 2081describe a combination of features including "wherein the one or more heaters comprise electrical heaters." The features of claims 2042 and 2081, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Amended claims 2043 and 2082 describe a combination of features including "wherein the one or more heaters comprise surface burners." The features of claims 2043 and 2082, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Amended claims 2050 and 2089 describe a combination of features including "wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C)." The features of claims 2050 and 2089, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Tsai appears to teach a temperature less than the softening temperature of coal. Tsai does not appear to teach or suggest that the thermal conductivity of the part of the formation is greater than about 0.5 W/(m °C) or that uniform heating is desired. Tsai states,

> Since the injection of the heated air should itself not cause the coal to swell, the maximum temperature of the injected air can be up to but not the same as the temperature at which the coal begins to soften...The range of about 150° C. to about 300° C is a particularly suitable operating range.
> (Column 3, lines 32-45).

Whether or not "a particular combination might be 'obvious to try' is not a legitimate test of patentability." *Id.* at 1599, citing *In re Geiqer*, 815 F.2d 868, 688, 2 USPQ2d 1276, 1278 (Fed. Cir. 1987) and *In re Goodwin*, 576 F.2d 375, 377, 198 USPQ 871, 881 (CCPA 1981). Consequently, it is not permissible for the Examiner to "use hindsight reconstruction to pick and chose among isolated disclosures in the prior art to deprecate the claimed invention." Id. at 1600.

The Examiner states, "With regards to claims 2051-2062, 2066, 2067, 2090-2101, 2105 and 2106; the nature of hydrocarbons produced from such heating is highly variable and dependent upon many factors, not least of which is the characteristics of the coal." Applicant

respectfully disagrees. Applicant submits that many of the dependent claims are separately patentable in combination with the features of the independent claims.

Claims 2051 and 2090 describe a combination of features including "wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°." Applicant specification teaches, "Condensable hydrocarbons" means the hydrocarbons that condense at 25 °C at one atmosphere absolute pressure. Condensable hydrocarbons may include a mixture of hydrocarbons having carbon numbers greater than 4." (Specification, page 33, lines 19-21).

Tsai does not appear to teach condensable hydrocarbons having an API gravity of at least 25°. Tsai appears to teach a product gas including methane. Tsai states, "The net result is a combustible product gas comprising carbon monoxide, hydrogen and some methane as its principle combustibles." (Column 5, lines 55-57).

Applicant submit that claims 2051 and 2090, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2052 and 2091 describe a combination of features including, "wherein the produced mixture comprises condensable hydrocarbons, and wherein about 0.1 % by weight to about 15 % by weight of the condensable hydrocarbons are olefins." For at least the reasons cited above, Applicant submits claims 2052 and 2091, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2053 and 2092 describe a combination of features including, "wherein the produced mixture comprises non-condensable hydrocarbons, and wherein a molar ratio of ethene to ethane in the non-condensable hydrocarbons ranges from about 0.001 to about 0.15." The

features of claims 2053 and 2092, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2054 and 2093 describe a combination of features including, "wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is nitrogen." The features of claims 2054 and 2093, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2055 and 2094 describe a combination of features including, "wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is oxygen." The features of claims 2055 and 2094, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2056 and 2095 describe a combination of features including, "wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is sulfur." The features of claims 2056 and 2095, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2057 and 2096 describe a combination of features including, "wherein the produced mixture comprises condensable hydrocarbons, wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons comprise oxygen containing compounds, and wherein the oxygen containing compounds comprise phenols." The features of claims 2057 and 2096, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2058 and 2097 describe a combination of features including, "wherein the produced mixture comprises condensable hydrocarbons, and wherein greater than about 20 % by

weight of the condensable hydrocarbons are aromatic compounds." The features of claims 2058 and 2097, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2059 and 2098 describe a combination of features including, "wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 5 % by weight of the condensable hydrocarbons comprises multi-ring aromatics with more than two rings." The features of claims 2059 and 2098, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2060 and 2099 describe a combination of features, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 0.3 % by weight of the condensable hydrocarbons are asphaltenes." The features of claims 2060 and 2099, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2061 and 2100 describe a combination of features including, "wherein the produced mixture comprises condensable hydrocarbons, and wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons are cycloalkanes." The features of claims 2061 and 2100, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Amended claims 2062 and 2101 describe a combination of features including, "wherein the produced mixture comprises a non-condensable hydrocarbons, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure. The features of claims 2062 and 2101, in combination with the features of

independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2066 and 2105 describe a combination of features including, "further comprising controlling formation conditions to produce the mixture, wherein a partial pressure of H_2 within the mixture is greater than about 0.5 bar." The features of claims 2066 and 2105, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2067 and 2106 describe a combination of feature including, "wherein the partial pressure of H_2 within the mixture is measured when the mixture is at a production well." The features of claims 2067 and 2106, in combination with the features of independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Applicant submits that portions of the aforementioned rejection appears to be set forth in facts within the personal knowledge of the Examiner. Applicant therefore believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicant requests this rejection be removed.

G. <u>The Claims Are Not Obvious Over Tsai In View of Elkins Pursuant To 35 U.S.C. § 103(a)</u>

The Examiner rejected claims 2046 and 2085under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 2,734,579 to Elkins (hereinafter "Elkins"). Applicant respectfully disagrees.

Amended claims 2046 and 2085 describe a combination of features including: "controlling a pressure and a temperature within at least a majority of the part of the formation,

wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure."

Elkins does not appear to teach or suggest controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure. Elkins appears to teach or suggest changing the pressure and/or concentration of the injected gas pressure to control the temperature. Elkins states,

> Control of the temperature within the reaction zone can be maintained in several ways. The increase in volume of oxygen-containing gas by application of higher injection gas pressure will increase this temperature. ...To keep the temperature from becoming too high, it is possible to dilute the air with inert gas, for example, by separating the inert gaseous products of combustion (principally oxides of nitrogen and carbon) from the produced hydrocarbons, and introducing it into the injection stream. ...Decreasing the injection gas pressure also decreases the combustion zone temperature.
> (Column 3, lines 26-46).

Applicant respectfully submits that the combination of features in dependent claims 2046 and 2085, in combination with the features of independent claims 2039 and 2078, respectively, do not appear to be taught or suggested by Tsai in view of Elkins.

H. <u>The Claims Are Not Obvious Over Tsai In View Of Kasevich et al. Pursuant To 35 U.S.C. § 103(a)</u>

The Examiner rejected claims 2047, 2048, 2086 and 2087 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,457,365 to Kasevich et al. (hereinafter "Kasevich"). Applicant respectfully disagrees.

Amended claims 2047 and 2086 describes a combination of features including, but not limited to: "controlling the heat such that an average heating rate of the part of the formation is

less than about 1 °C per day during pyrolysis within a pyrolysis temperature range of about 270 °C to about 400 °C."

Kasevich does not appear to teach or suggest the features of the claim. Referring to Figure 3, Kasevich appears to teach a heating rate of 50 °C/month, which may correspond to an average heating rate of about 1.6 °C/day. Kasevich states,

> Thus, if the kerogen were heated from 150 °C. to 500 °C. at the rate of 50 °C./month, the absorption rate would approximate that of curve 114 [in Figure 3], while more rapid heating rates would produce curves 120, 122 and 124 for heating rates of 50 °C. per month, 50 °C./day, 50 °C./hour and 50 °C./minute, respectively."
> (Column 8, lines 57-62).

The Examiner states, however: "It is apparent that when the temperature reaches its highest point (the point at which pyrolysis occurs) the rate of increase would be at the slowest; thus it would be less than about 1 °C/day."

Applicant respectfully submits that the Examiner appears to be using personal knowledge to extend the teaching of Kasevich. Applicant submits that the cited art does not appear to teach or suggest the features of claim 2074 and 2086 in combination with the features of independent claims 2039 and 2078.

Amended claim 2048 and 2087 describe a combination of features including but not limited to, "wherein heating energy/day (*Pwr*) provided to the volume is equal to or less than $h*V*C_v*\rho_B$; wherein ρ_B is average formation bulk density, and wherein an average heating rate (*h*) of the selected volume is about 10 °C/day."

Kasevich does not appear to teach or suggest using a desired heating rate to calculate a maximum amount of heating energy/day to be applied to a selected volume of a formation. Applicant submits that Kasevich in combination with Tsai does not appear to teach or suggest the

features of claims 2048 and 2087 in combination with the features of independent claims 2039 and 2078.

Applicant further submits that Tsai in combination with Kasevich does not appear to teach or suggest the features of claims 2047, 2048, 2086 and 2087 in combination with independent claims 2039 and 2078. Kasevich appears to teach heating kerogen in oil shale and not coal with electric heaters while Tsai appears to teach burning coal.

Kasevich states: "this invention provides for heating kerogen in oil shale with electric fields having frequency components in the range between 100 kilohertz and 100 megahertz where dry oil shale is selectively heated, with kerogen-rich regions absorbing energy from said fields at substantially higher rates than kerogen-lean regions." (Column 2, lines 9-15).

Tsai states: "This invention relates to the in situ combustion and gasification of a swelling bituminous coal by the injection of air for combustion into the coal bed from one or more injection holes and the production of a combustible gas from one or more production holes." (Column 1, lines 6-10).

Whether an art is predictable or whether the proposed modification or combination of the prior art has a reasonable expectation of success is determined at the time the invention was made. *Ex parte Erlich*, 3 USPQ2d 1011 (Bd. Pat. App. & Inter. 1986), MPEP, 8th Ed. Page 2100-126.

Applicant respectfully submits that the features of the electric field heating method of Kasevich for an oil shale formation would not be suitable for modifying the in situ combustion process of Tsai for a coal formation to produce features of Applicant's claims. Thus, Applicant submits that the combination of features in claims 2047, 2048, 2086 and 2087 in combination with independent claims 2039 and 2078, respectively, do not appear to be taught or suggested by Tsai in view of Kasevich.

I. The Claims Are Not Obvious Over Tsai In View of Stoddard et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2063, 2064, 2102 and 2103 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,463,807 to Stoddard et al. (hereinafter "Stoddard"). Applicant respectfully disagrees.

Claims 2063 and 2064 describe a combination of features including, "wherein the produced mixture comprises ammonia, and wherein greater than about 0.05% by weight of the produced mixture is ammonia."

Stoddard does not appear to teach a produced mixture with a ammonia concentration is greater than 0.05% by weight. Stoddard appears to teach a reaction product that includes ammonia. Stoddard states, "A seal against water incursion serves two purposes: water is excluded from the georeactor and the processes underway, and water soluble products of reactions (phenols, ammonia and the like) are excluded from the aquifer." (Column 3, lines 28-31).

Applicant submits that Stoddard in combination with Tsai does not appear to teach or suggest the features of the claims 2063 and 2102 in combination with the features of independent claims 2039 and 2078, respectively.

Claims 2064 and 2103 describe a combination of features including, " wherein the produced mixture comprises ammonia and wherein the ammonia is used produce fertilizer." Applicant submits that the features of claims 2064 and 2103 in combination with the features of independent claims 2039 and 2078 respectively, are not taught by the cited art.

J. The Claims Are Not Obvious Over Tsai In View of Gregoli et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2068-2071 and 2107-2110 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 6,016,867 to Gregoli et al. (hereinafter

"Gregoli"). Applicant respectfully disagrees.

Claims 2068 and 2107 describe a combination of features including: "altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25."

Gregoli does not appear to teach or suggest at least the feature of "altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25" in combination with the other features of the claims. Gregoli appears to teach converting higher molecular-weight components into lower molecular weight component, Gregoli states,

> Heavy hydrocarbons 207 in the reservoir 27 are heated by the hot injected fluids which, in the presence of hydrogen, initiate hydrovisbreaking reactions. These reactions upgrade the quality of the hydrocarbons by converting their higher molecular-weight components into lower molecular-weight components which have less density, lower viscosity, and greater mobility within the reservoir than the unconverted hydrocarbons. The hydrocarbons subjected to hydrovisbreaking reactions and additional virgin hydrocarbons flow into the perforations 203 of the casing 202 of the production-well borehole 201, propelled by the pressure of the injected fluids.
> (Column 12, lines 35-46)

Applicant submits that the of features in claims 2068 and 2107, in combination with the features of independent claims 2039 and 2078, do not appear to be taught or suggested by the cited art.

Claims 2069 and 2108 describe a combination of features including: "recirculating a portion of hydrogen from the mixture into the formation." Gregoli does not appear to teach or suggest at least the feature of "recirculating a portion of hydrogen from the mixture into the formation" in combination with the other features of the claims. Gregoli appears to teach hydrogen being fed to the downhole combustion unit. Gregoli states,

> Preferably, a stoichiometric mixture of hydrogen and oxygen is initially fed to the downhole combustion unit 206 so that the sole product of combustion is superheated steam. As the reservoir becomes heated to the level necessary for the occurrence of hydrovisbreaking reactions, it is preferable that a stoichiometric excess of hydrogen be fed to the downhole combustion unit during its operation - or that hydrogen be injected into the reservoir along with superheated steam. (Column 14, lines 28-38).

Gregoli further discloses:

> The hydrocarbons subjected to the hydrovisbreaking reactions and additional virgin hydrocarbons, propelled by the pressure of the injected fluids, flow into the vertical fractures 211 of the reservoir 27 and thence into the horizontal producing wells intersecting the fractures, where they are recovered along with the injected fluids using conventional oil-field technology.
> (Column 15, lines 26-33).

Applicant submits that the of features in claims 2069 and 2108, in combination with the features of independent claims 2039 and 2078, do not appear to be taught or suggested by the cited art.

Amended claims 2070 and 2109 describe a combination of features including: "providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons within the part of the formation; and heating a portion of the part of the formation with heat from hydrogenation." Gregoli does not appear to teach or suggest at least the features of "providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons within the part of the formation; and heating a portion of the part of the formation with heat from hydrogenation" in combination with the other features of the claims. Gregoli appears to teach providing superheated steam. Gregoli states,

> The superheated steam resulting from using partially saturated steam to absorb the heat of combustion in the combustion unit and the hot reducing gases exiting the combustion unit are then injected into the formation to provide the thermal energy and reactants required for the process.
> (Column 8, lines 54-58).

Applicant submits that the combination of features in claims 2070 and 2109, in

combination with the features of independent claim 2039 and 2078, for at least the reasons cited above, do not appear to be taught or suggested the cited art.

Claims 2071 and 2110 describe a combination of features including: "producing hydrogen and condensable hydrocarbons from the formation; and hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen." The combination of features in claims 2071 and 2110, in combination with the features of independent claims 2039 and 2078, do not appear to be taught or suggested by the cited art.

K. <u>The Claims Are Not Obvious Over Tsai In View of Van Meurs et al. Pursuant To 35 U.S.C. § 103(a)</u>

The Examiner rejected claims 2075, 2076, 2114 and 2115, under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,886,118 to Van Meurs et al. (hereinafter "Van Meurs"). Applicant respectfully disagrees.

Amended claims 2075 and 2114 describes a combination of features including, "wherein at least about 7 heaters are disposed in the formation for each production well." The features of claims 2075 and 2114, in combination with the features of the independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Claims 2076 and 2115 describe a combination of features including, "further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern." The features of claims 2075 and 2115, in combination with the features of the independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

Applicant submits that Tsai in combination with Van Meurs does not appear to teach or suggest the features of claims 2075, 2076, 2114 and 2115 combination with independent claims 2039 and 2078. Van Meurs appears to teach heating kerogen in oil shale and not coal by means

of conductive heat while Tsai appears to teach burning coal.

Van Meurs states: "Shale oil is produced from a subterranean interval of oil shale....Said interval is conductively heated from borehole interiors" (Abstract).

Tsai states: "This invention relates to the in situ combustion and gasification of a swelling bituminous coal by the injection of air for combustion into the coal bed from one or more injection holes and the production of a combustible gas from one or more production holes." (Tsai, column 1, lines 6-10).

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck,* 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991), MPEP § 2143.

Applicant submits that the combination of features in claims 2075, 2076, 2114 and 2115 in combination with the features of the independent claims 2039 and 2078 respectively, do not appear to be taught or suggested by the cited art.

L. <u>The Claims Are Not Obvious Over Tsai In View of Van Meurs And In Further View of Salomonsson Pursuant To 35 U.S.C. § 103(a)</u>

The Examiner rejected claims 2077 and 2116 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view Van Meurs and in further view of U.S. Patent No. 2,914,309 to Salomonsson (hereinafter "Salomonsson"). Applicant respectfully disagrees.

Claims 2077 and 2116 describe a combination of features including, "further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units." The features of claims 2077 and 2116, in

combination with the features of the independent claims 2039 and 2078, do not appear to be taught or suggested by the cited art.

M. Summary

Applicant submits that all claims are in condition for allowance. Favorable consideration is respectfully requested.

Enclosed is a fee authorization for excess claims fees and the fee due for consideration of an Information Disclosures Statement. If any extension of time is needed, Applicant requests the appropriate extension of time. If any additional fees are required or if any fees are overpaid, please appropriately charge or deposit those fees to Conley, Rose & Tayon, P.C. Deposit Account Number 50-1505/5659-05900/EBM.

Respectfully submitted,

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